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(19) (CA) **CANADIAN PATENT** (12)

(54) Actuator for Needleless Disposable Syringe

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(73) Granted to Advanced Medical Technologies (1988) Inc.
Canada

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No. OF CLAIMS 13

Canada

Abstract:

An actuator is described for a needleless disposable syringe. The actuator includes a hollow substantially cylindrical front section and a hollow substantially cylindrical rear section. The front section has an open rear end and a front end merging into an outwardly extending neck portion. This neck portion defines an axial opening and a tubular inner member extends axially within the cylindrical front section from the neck portion. The tubular inner member is adapted to retain a disposable syringe of the type having a hollow medicine holding cylinder with an orifice in one end and a piston slidably mounted in the other end. The rear section is a power pack which includes spring means in the form of a plurality of disc springs for driving the piston in the front section from a retracted position in which the medicine holding cylinder contains a substance to be administered to an extended position in which the substance is substantially completely discharged through the orifice. A bushing is slidably mounted between the piston and the spring means and is capable of engaging the piston as it travels from the retracted position to the extended position. Latch means is also provided for locking the bushing and spring means in the retracted position.

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Actuator for Needleless Disposable SyringeBackground of the Invention

This invention relates to an actuator for a needleless hypodermic injector, more particularly for a needleless disposable syringe.

There is a wide spread interest in the use of needleless injectors for the injection of medicines into the body of both humans and animals. A needleless jet injector makes a substantially smaller hole than does a needle, and consequently needleless injection is less painful than injection with a needle. Moreover, for people requiring frequent injections, e.g., diabetics, needleless injection has the important advantage of causing less damage to the skin and tissue. This is very significant, since the areas on the body which can be used for injection are limited.

An important advance in needleless jet injectors is described in Lindmayer, et al, Canadian Patent 1,178,503, issued November 27, 1984. This is a very compact needleless jet injector in which the drive means comprises a series of axially aligned disc springs adapted to move an injector piston such that the discharge pressure remains substantially constant or increasing throughout the injection following the initial high pressure skin piercing stage.



The injector described in that application is an extremely high quality device made of stainless steel and contains within it a medicine holding cylinder into which the medicine is drawn for subsequent injection. This device must be sterilized on a regular basis.

It is the object of the present invention to provide an actuator for a disposable syringe can be thrown away after use thereby avoiding the need for frequent sterilization.

It is a further object of the present invention to provide an actuator for a disposable syringe which can be made from inexpensive materials such as plastics, light alloys, etc.

Summary of the Invention

The present invention in its broadest aspect relates to an actuator for a needleless disposable syringe comprising a hollow substantially cylindrical front section and a hollow substantially cylindrical rear section. The front section has an open rear end and the front end merges into an outwardly extending neck portion. This neck portion defines an axial opening and a tubular inner member extends axially from the axial opening into the tubular front section. This tubular inner member is adapted to retain a disposable syringe of the type having a hollow medicine holding cylinder with an orifice in one end and a piston slidably mounted in the other end.

The rear section of the actuator comprises a power pack in the form of a plurality of axially aligned disc springs for driving the piston of the syringe in the front section from a retracted position in which the medicine holding cylinder contains the substance to be administered to an extended position in which the substance is substantially completely discharged through the orifice. A bushing is slidably mounted between the piston and the disc springs and is capable of engaging

the piston as it travels from the retracted position to the extended position. Latch means is also provided for locking the bushing and spring means in the retracted position.

5 The disposable syringe can be made from an inexpensive plastic material, as can the front and rear sections of the actuator. The neck on the front end of the actuator preferably has an internal thread which mates with an external thread on the syringe so that the syringe can be
10 inserted through the neck and screwed into place.

 The tubular inner member of the front section is preferably made from a metal and includes an external thread. This thread mates with an internal thread in the lower end of the rear section of the actuator. The power pack mechanism is essentially the same as that described in
15 Canadian Patent 1,178,503.

Brief Description of the Drawings

 The invention will now be described in greater detail with reference to the accompanying drawings, which illustrate preferred embodiments of the invention, and wherein:
20 Figure 1 is an elevation view in partial section of the actuator of the present invention;

 Figure 2 is an elevation view in partial section of a disposable syringe;

25 Figure 3 is an end elevation of the syringe of Figure 2;

 Figure 4 is an elevation view in partial section showing a cap-wrench for the disposable syringe;

30 Figure 5 is an end elevation of the cap-wrench shown in Figure 4;

 Figure 6 is a sectional view of the actuator connected to a medicine vial;

35 Figure 7 is an elevation view in partial section of the actuator of the invention with an injector cap in position;

Figure 8 is a sectional view of an injector cap; and
Figure 9 is a end elevation of the injector cap of
Figure 8.

Description of Preferred Embodiments

5 As can be seen from Figures 1 and 6, the actuator of the invention includes a hollow cylindrical front section 10 and a hollow cylindrical rear section 11. The front section is the injector portion and the rear section is the power pack assembly.

10 The front section 10 includes a cylindrical wall 12 having at the front end thereof a neck portion 13. The outer surface of this neck 13 includes a bayonet connection or thread 14. Within an axial opening in the neck 13 is mounted a metal tube 15 which extends into the injector. Adjacent the outer end of tube 15 is an internal thread 16 for receiving a disposable syringe. The tube 15 also includes along its main body portion an external thread 17.

20 The front section 10 also includes a window-lens 18 through which numbers can be seen indicative of the units of medicine loaded into the syringe.

The rear section 11 includes a cylindrical wall 20 with projecting wings 21 providing convenient means for gripping the actuator. The rearward end of the rear section 11 includes a trigger button 22 for firing the injector via tripper pin 34. This trigger button 22 is spring biased outwardly by means of a coil spring 24. The rearward end of the rear section 11 also includes a strong retaining wall 23 defining the upper end of a power chamber containing a plurality of axially aligned disc springs 25. The lower end of the bank of disc springs presses against a cup-shaped bushing 26 having a bottom wall with an axially opening 30. It also includes in the side wall thereof several holes 27 each containing a hard ball 28. The cylindrical wall 20 also

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includes recesses 29 in longitudinal alignment with the holes 27.

5 Within the cup-shaped bushing 26 is a lock collar 31 with an inclined shoulder portion in the side wall thereof. This shoulder acts as a cam in relation to the balls 28. The shoulder is biased against the balls 28 by means of a coil spring 32.

10 A typical disposable syringe for use in the above actuator is shown in Figures 2 and 3. This syringe 40 includes a hollow cylindrical side wall 41 with a threaded portion 42 adjacent the front end thereof. The front end comprises an enlarged conical tip 43 with a spherically rounded end tip 45. The large diameter end of the conical section includes a plurality of longitudinal slots 44 and
15 the end tip contains an axial orifice 46.

 Within the cylindrical wall 41 is positioned a piston 47 having a conical inner end tip 48 and an annular recess holding an O-ring of 49. The outer end of the piston 47 includes a shoulder portion 50 and an axial projection 51. This projection includes a collar 52 and its
20 outer end is bifurcated by means of a longitudinal slot.

 The disposable syringe is preferably provided with a snug fitting end cap-wrench 55 as shown in Figures 4 and 5. This end cap 55 includes a cylindrical side wall 56
25 with a hollow interior divided by a divider wall 57 into two compartments 58 and 59. Each of these compartments includes a plurality of radial splines 60 which are adapted to engage the slots 44 in the end tip 43 of the disposable syringe 40.

30 With the cap-wrench 55 in place as shown, the compartment 59 is placed over the end tip of a used disposable syringe in the actuator and is used as a wrench for removing the disposable syringe. The used disposable syringe can then be thrown away and the cap-wrench 55
35 still holding the fresh syringe 40 is then used as a

wrench to install the fresh syringe. In this manner the end tip 43 of the fresh syringe 40 can be kept clean and sterile while be installed in the actuator. When this has been completed, the cap-wrench is also thrown away.

5 When the syringe is installed, the piston extension 51 is forced into the bottom hole 30 of bushing 26 with the collar 52 being forced entirely through hole 30. Thus, by pulling against collar 52 the bushing 26 can pull the piston 47 rearwardly and by pushing against
10 shoulder 50 the bushing 26 can push the piston forwardly.

 The rear section 11 of the actuator is screwed into the front section until the piston of the syringe is at the foremost end thereof. This twisting action is continued to compress the disc springs 25 between the wall
15 23 and the cup-shaped bushing 26 until the balls 28 come into alignment with the wall recesses 29. At this point, the cam shoulder of the lock collar 31 forces the balls outwardly into the recesses 29. This serves to lock the mechanism in the loaded position.

20 A medicine vial adaptor 81 is then twisted onto the neck 13 and connected to a medicine vial 80 as shown in Figure 6. The adaptor 81 includes a hollow cylindrical body 82 containing therein a sharp tipped, tapered probe
25 83 which pierces the top of vial 80. The probe 83 has an axial bore therethrough with an outlet in a concave face 84. This outlet mates with the orifice 46 in the tip of the syringe 40.

 With adaptor 81 and vial 80 in place, the rear section
30 11 of the actuator is twisted in the reverse direction so that the piston 47 is pulled rearwardly, drawing medicine into the syringe 40. When the appropriate dosage has been

loaded as indicated in the window-lens 18, the twisting in the loading direction is stopped. Then the rear section 11 is given several turns in the reverse direction to provide a desired initial impact gap. This is a gap
5 between the bottom of bushing 26 and piston shoulder 50, which creates the high initial skin piercing pressure when the injector is fired.

At this point, the medicine vial 80 and adaptor 81 are removed from neck 13 and a nozzle cap 65 is installed. The nozzle cap 65 includes a cylindrical side wall
10 66 and an end wall 67 with a hole 69 therein. It also includes internal bayonet connections 68. Within the cap is a thin metal insert having an spherically rounded projection 70 merging into a flat edge flange 71. At the
15 centre of the spherically rounded portion is an injection orifice 72.

A spring means 73 is provided behind the edge flange 71 and this serves to hold the inner face of the metal portion 70 into tight proximity with the outer face of
20 disposable syringe tip 45. The injector tip 65 may be conveniently kept with the actuator by means of a strap 75 which connects to the cap by means of a ring 76.

With the injector tip 65 in position, the injector tip is firmly held in a perpendicular position to the
25 skin. The trigger button 22 is then pushed, causing pin 34 to push the step collar 31 downwardly, thereby releasing the balls from the locking recesses 29 and firing mechanism.

Claims:

1. An actuator for a needleless disposable syringe, comprising (a) a hollow substantially cylindrical front section having an open rear end and having a front end merging into an outwardly extending neck portion, said
5 neck portion defining an axial opening and a tubular inner member extending axially within said cylindrical front section from said neck portion, said tubular inner member being adapted to retain therein a disposable syringe of
10 the type comprising a hollow medicine holding cylinder having an axial orifice in one end thereof and having a piston slidably mounted in the other end thereof, and (b) a hollow cylindrical rear section comprising spring means in the form of a plurality of disc springs for driving the
15 piston in the front section from a retracted position in which the medicine holding cylinder contains a substance to be administered to an extended position in which the substance is substantially completely discharged through the orifice, a bushing slidably mounted between the pis-
20 ton and the spring means and capable of engaging the piston as it travels from the retracted position to the extended position and latch means for locking the bushing and spring means in the retracted position.
2. An actuator according to claim 1 wherein the
25 axial opening in the neck portion contains an internal thread adapted to mate with an external thread on a disposable syringe.
3. An actuator according to claim 2 wherein said front and rear sections are made of plastic material.
- 30 4. An actuator according to claim 2 wherein said tubular inner member has an external thread adapted to mate with an internal thread in the forward end of said rear section.
5. An actuator according to claim 4 wherein said



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Actuator for Needleless Disposable SyringeBackground of the Invention

5 This invention relates to an actuator for a needleless hypodermic injector, more particularly for a needleless disposable syringe.

10 There is a wide spread interest in the use of needleless injectors for the injection of medicines into the body of both humans and animals. A needleless jet injector makes a substantially smaller hole than does a needle, and consequently needleless injection is less painful than injection with a needle. Moreover, for people requiring frequent injections, e.g., diabetics, needleless injection has the important advantage of causing less damage to the skin and tissue. This is very significant, since
15 the areas on the body which can be used for injection are limited.

An important advance in needleless jet injectors is described in Lindmayer, et al, Canadian Patent 1,178,503, issued November 27, 1984. This is a very compact needleless jet injector in which the drive means comprises a series of axially aligned disc springs adapted to move an injector piston such that the discharge pressure remains substantially constant or increasing throughout the injection following the initial high pressure skin
20 piercing stage.
25



The injector described in that application is an extremely high quality device made of stainless steel and contains within it a medicine holding cylinder into which the medicine is drawn for subsequent injection. This device must be sterilized on a regular basis.

5 It is the object of the present invention to provide an actuator for a disposable syringe can be thrown away after use thereby avoiding the need for frequent sterilization.

10 It is a further object of the present invention to provide an actuator for a disposable syringe which can be made from inexpensive materials such as plastics, light alloys, etc.

Summary of the Invention

15 The present invention in its broadest aspect relates to an actuator for a needleless disposable syringe comprising a hollow substantially cylindrical front section and a hollow substantially cylindrical rear section. The front section has an open rear end and the front end merges into an outwardly extending neck portion. This neck portion defines an axial opening and a tubular inner member extends axially from the axial opening into the tubular front section. This tubular inner member is adapted to retain a disposable syringe of the type having a hollow medicine holding cylinder with an orifice in one end and a piston slidably mounted in the other end.

25 The rear section of the actuator comprises a power pack in the form of a plurality of axially aligned disc springs for driving the piston of the syringe in the front section from a retracted position in which the medicine holding cylinder contains the substance to be administered to an extended position in which the substance is substantially completely discharged through the orifice. A bushing is slidably mounted between the piston and the disc springs and is capable of engaging

the piston as it travels from the retracted position to the extended position. Latch means is also provided for locking the bushing and spring means in the retracted position.

5 The disposable syringe can be made from an inexpensive plastic material, as can the front and rear sections of the actuator. The neck on the front end of the actuator preferably has an internal thread which mates with an external thread on the syringe so that the syringe can be
10 inserted through the neck and screwed into place.

 The tubular inner member of the front section is preferably made from a metal and includes an external thread. This thread mates with an internal thread in the lower end of the rear section of the actuator. The power pack mechanism is essentially the same as that described in
15 Canadian Patent 1,178,503.

Brief Description of the Drawings

 The invention will now be described in greater detail with reference to the accompanying drawings, which illustrate preferred embodiments of the invention, and wherein:
20 Figure 1 is an elevation view in partial section of the actuator of the present invention;

 Figure 2 is an elevation view in partial section of a disposable syringe;

25 Figure 3 is an end elevation of the syringe of Figure 2;

 Figure 4 is an elevation view in partial section showing a cap-wrench for the disposable syringe;

30 Figure 5 is an end elevation of the cap-wrench shown in Figure 4;

 Figure 6 is a sectional view of the actuator connected to a medicine vial;

35 Figure 7 is an elevation view in partial section of the actuator of the invention with an injector cap in position;

Figure 8 is a sectional view of an injector cap; and
Figure 9 is a end elevation of the injector cap of
Figure 8.

Description of Preferred Embodiments

5 As can be seen from Figures 1 and 6, the actuator of
the invention includes a hollow cylindrical front section
10 and a hollow cylindrical rear section 11. The front
section is the injector portion and the rear section is
the power pack assembly.

10 The front section 10 includes a cylindrical wall 12
having at the front end thereof a neck portion 13. The
outer surface of this neck 13 includes a bayonet connec-
tion or thread 14. Within an axial opening in the neck
13 is mounted a metal tube 15 which extends into the in-
15 jector. Adjacent the outer end of tube 15 is an inter-
nal thread 16 for receiving a disposable syringe. The
tube 15 also includes along its main body portion an
external thread 17.

20 The front section 10 also includes a window-lens 18
through which numbers can be seen indicative of the units
of medicine loaded into the syringe.

The rear section 11 includes a cylindrical wall 20
with projecting wings 21 providing convenient means for
gripping the actuator. The rearward end of the rear
25 section 11 includes a trigger button 22 for firing the
injector via tripper pin 34. This trigger button 22 is
spring biased outwardly by means of a coil spring 24.
The rearward end of the rear section 11 also includes
a strong retaining wall 23 defining the upper end of a
30 power chamber containing a plurality of axially aligned
disc springs 25. The lower end of the bank of disc
springs presses against a cup-shaped bushing 26 having
a bottom wall with an axially opening 30. It also in-
cludes in the side wall thereof several holes 27 each
35 containing a hard ball 28. The cylindrical wall 20 also

includes recesses 29 in longitudinal alignment with the holes 27.

5 Within the cup-shaped bushing 26 is a lock collar 31 with an inclined shoulder portion in the side wall thereof. This shoulder acts as a cam in relation to the balls 28. The shoulder is biased against the balls 28 by means of a coil spring 32.

10 A typical disposable syringe for use in the above actuator is shown in Figures 2 and 3. This syringe 40 includes a hollow cylindrical side wall 41 with a threaded portion 42 adjacent the front end thereof. The front end comprises an enlarged conical tip 43 with a spherically rounded end tip 45. The large diameter end of the conical section includes a plurality of longitudinal slots 44 and 15 the end tip contains an axial orifice 46.

 Within the cylindrical wall 41 is positioned a piston 47 having a conical inner end tip 48 and an annular recess holding an O-ring of 49. The outer end of the piston 47 includes a shoulder portion 50 and an axial projection 51. This projection includes a collar 52 and its 20 outer end is bifurcated by means of a longitudinal slot.

 The disposable syringe is preferably provided with a snug fitting end cap-wrench 55 as shown in Figures 4 and 5. This end cap 55 includes a cylindrical side wall 56 25 with a hollow interior divided by a divider wall 57 into two compartments 58 and 59. Each of these compartments includes a plurality of radial splines 60 which are adapted to engage the slots 44 in the end tip 43 of the disposable syringe 40.

30 With the cap-wrench 55 in place as shown, the compartment 59 is placed over the end tip of a used disposable syringe in the actuator and is used as a wrench for removing the disposable syringe. The used disposable syringe can then be thrown away and the cap-wrench 55 35 still holding the fresh syringe 40 is then used as a

wrench to install the fresh syringe. In this manner the end tip 43 of the fresh syringe 40 can be kept clean and sterile while be installed in the actuator. When this has been completed, the cap-wrench is also thrown away.

5 When the syringe is installed, the piston extension 51 is forced into the bottom hole 30 of bushing 26 with the collar 52 being forced entirely through hole 30. Thus, by pulling against collar 52 the bushing 26 can pull the piston 47 rearwardly and by pushing against
10 shoulder 50 the bushing 26 can push the piston forwardly.

The rear section 11 of the actuator is screwed into the front section until the piston of the syringe is at the foremost end thereof. This twisting action is continued to compress the disc springs 25 between the wall
15 23 and the cup-shaped bushing 26 until the balls 28 come into alignment with the wall recesses 29. At this point, the cam shoulder of the lock collar 31 forces the balls outwardly into the recesses 29. This serves to lock the mechanism in the loaded position.

20 A medicine vial adaptor 81 is then twisted onto the neck 13 and connected to a medicine vial 80 as shown in Figure 6. The adaptor 81 includes a hollow cylindrical body 82 containing therein a sharp tipped, tapered probe
25 83 which pierces the top of vial 80. The probe 83 has an axial bore therethrough with an outlet in a concave face 84. This outlet mates with the orifice 46 in the tip of the syringe 40.

30 With adaptor 81 and vial 80 in place, the rear section 11 of the actuator is twisted in the reverse direction so that the piston 47 is pulled rearwardly, drawing medicine into the syringe 40. When the appropriate dosage has been

loaded as indicated in the window-lens 18, the twisting in the loading direction is stopped. Then the rear section 11 is given several turns in the reverse direction to provide a desired initial impact gap. This is a gap
5 between the bottom of bushing 26 and piston shoulder 50, which creates the high initial skin piercing pressure when the injector is fired.

At this point, the medicine vial 80 and adaptor 81 are removed from neck 13 and a nozzle cap 65 is installed. The nozzle cap 65 includes a cylindrical side wall
10 66 and an end wall 67 with a hole 69 therein. It also includes internal bayonet connections 68. Within the cap is a thin metal insert having an spherically rounded projection 70 merging into a flat edge flange 71. At the
15 centre of the spherically rounded portion is an injection orifice 72.

A spring means 73 is provided behind the edge flange 71 and this serves to hold the inner face of the metal portion 70 into tight proximity with the outer face of
20 disposable syringe tip 45. The injector tip 65 may be conveniently kept with the actuator by means of a strap 75 which connects to the cap by means of a ring 76.

With the injector tip 65 in position, the injector tip is firmly held in a perpendicular position to the
25 skin. The trigger button 22 is then pushed, causing pin 34 to push the step collar 31 downwardly, thereby releasing the balls from the locking recesses 29 and firing mechanism.

Claims:

1. An actuator for a needleless disposable syringe, comprising (a) a hollow substantially cylindrical front section having an open rear end and having a front end
5 merging into an outwardly extending neck portion, said neck portion defining an axial opening and a tubular inner member extending axially within said cylindrical front section from said neck portion, said tubular inner member being adapted to retain therein a disposable syringe of
10 the type comprising a hollow medicine holding cylinder having an axial orifice in one end thereof and having a piston slidably mounted in the other end thereof, and (b) a hollow cylindrical rear section comprising spring means in the form of a plurality of disc springs for driving the
15 piston in the front section from a retracted position in which the medicine holding cylinder contains a substance to be administered to an extended position in which the substance is substantially completely discharged through the orifice, a bushing slidably mounted between the piston
20 and the spring means and capable of engaging the piston as it travels from the retracted position to the extended position and latch means for locking the bushing and spring means in the retracted position.
2. An actuator according to claim 1 wherein the
25 axial opening in the neck portion contains an internal thread adapted to mate with an external thread on a disposable syringe.
3. An actuator according to claim 2 wherein said front and rear sections are made of plastic material.
- 30 4. An actuator according to claim 2 wherein said tubular inner member has an external thread adapted to mate with an internal thread in the forward end of said rear section.
5. An actuator according to claim 4 wherein said

neck portion has an external thread.

6. An actuator according to claim 4 wherein the external face of said neck includes a bayonet connection.

5 7. A disposable syringe for use with the actuator of claim 1, comprising a hollow cylindrical casing and a slideable piston therein, said casing having at the front end thereof an enlarged conical end portion merging into spherically rounded end tip with an axial orifice extending therethrough and a piston having at the outer end
10 thereof connector means for connection to the actuator bushing.

8. A disposable syringe according to claim 7, including an external threaded portion adjacent said conical end portion adapted to mate with an internal thread
15 in said actuator neck.

9. A disposable syringe according to claim 8, wherein the forward interior end of said hollow casing is conical and the inner end of said piston has a mating conical shape.

20 10. A disposable syringe according to claim 9, wherein the outer end of the piston includes a shoulder portion for pushing the piston into the hollow casing and a collar portion adapted to snap into said actuator bushing for pulling the piston outwardly.

25 11. A disposable syringe according to claim 10, wherein the outer end of the piston is bifurcated.

12. A disposable syringe according to claim 8, which includes longitudinal slots in the large periphery of the conical end portion.

30 13. A disposable syringe according to claim 12, in combination with a cap-wrench therefor, said cap-wrench serving as a protective cap for a new syringe and serving as a wrench for removing a used syringe from an actuator and installing a new syringe, and comprising a
35 hollow cylindrical body portion divided by an internal

divider wall into two end compartments for receiving syringe conical end portions, each compartment having a series of radial splines adapted to engage the longitudinal slots in a conical syringe end.



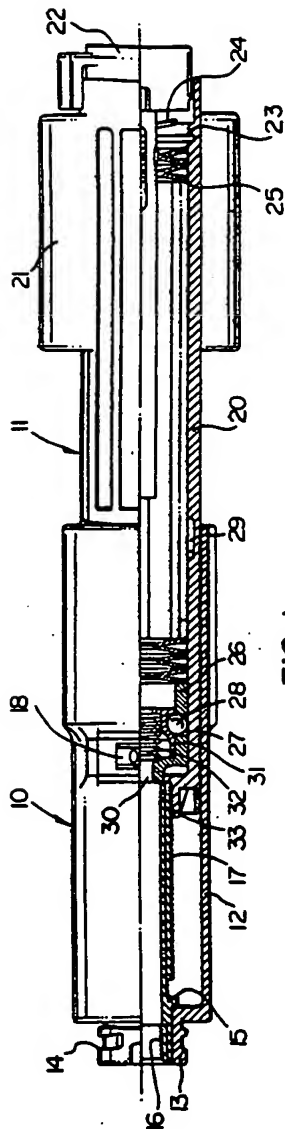


FIG. 1

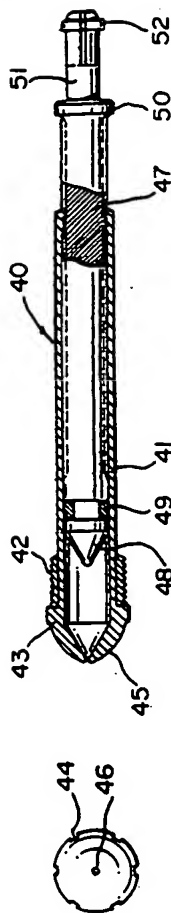


FIG. 2



FIG. 3

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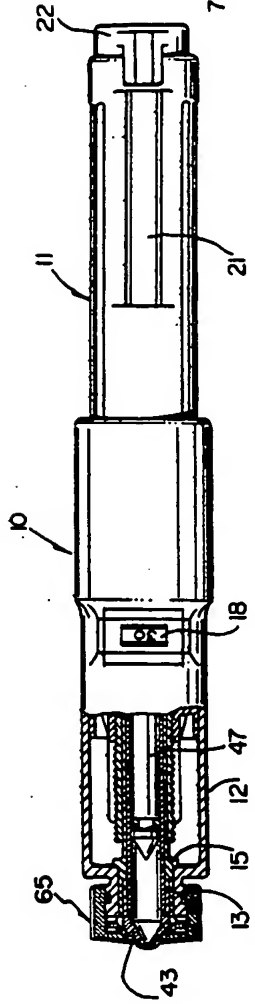


FIG. 7

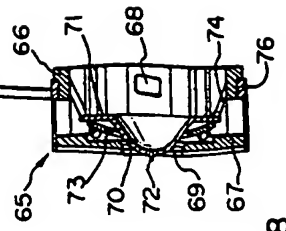


FIG. 8

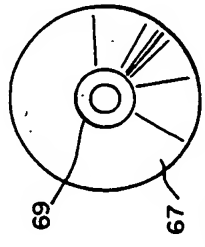


FIG. 9

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